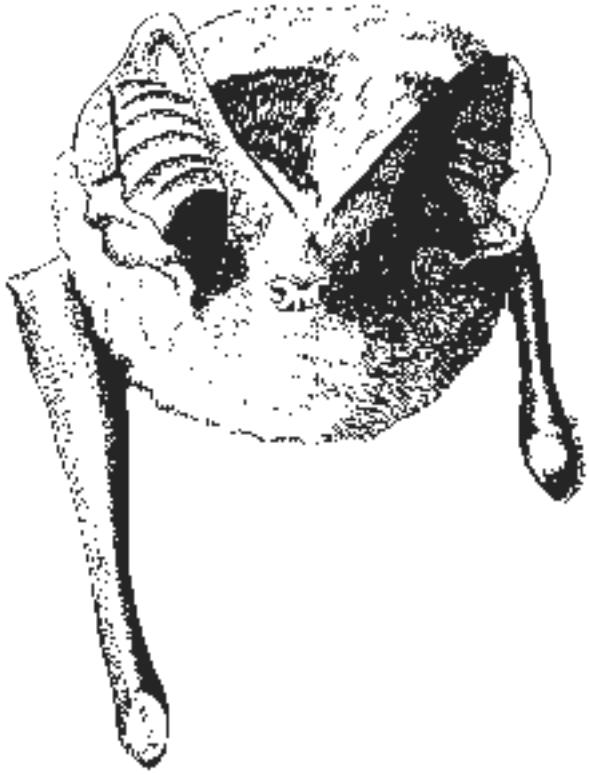
BATS

WHAT ARE BATS?



Bats are mammals; they have fur, give live birth, and feed milk to their young. They are the only mammals capable of true flight. Although the German word for bat, fledermaus, translates to “flying mouse”, bats are not rodents. They are more closely related to primates than they are to mice. However, biologists have placed bats in their own order, Chiroptera. Chiroptera means hand-wing; bats’ wings are supported by the bones in the bat’s equivalent of human hands.

Chiroptera is a large order of over 900 species, accounting for one quarter of the world’s mammals. One out of every four mammals is a bat!

Bats are truly marvels of evolution and adaptation, living on every continent except Antarctica, filling a wide variety of niches in many different ecosystems. They range in size from the world’s smallest mammal - the hog-nosed bat is the size of a large bumble bee - to the flying foxes with their 6-foot wingspans.

ARE BATS BLIND?

Despite popular beliefs, bats are not blind. They can see, but they also use an advanced system of high frequency sounds to “see” with their ears. This natural form of sonar is called echolocation and is also used by whales, dolphins, and shrews. Not all bats rely on echolocation; fruit bats rely heavily on their sense of smell to sniff out ripening fruit.

Another common myth is that bats are carriers of rabies and can transmit the disease while being immune to it themselves. But like all mammals, bats can contract the disease, though less than one percent of all bats do so and those that do die quickly and rarely become aggressive.

Although by nature bats are very docile creatures, it is still important to remember that they are wild animals. Bats will bite in self-defense. Children should be warned that while it is all right to observe wild animals, they should leave them alone. Any wild animal that can be caught is likely to be sick. The majority of sick bats are not rabid, but children should inform adults when they find what appears to be an ill bat on the ground. Adults can use leather work gloves or a towel to move a grounded bat to an area away from contact with people and pets.

WHAT DO BATS EAT?

Most bats eat insects and they are the primary predators of the night-flying insects such as moths, mosquitoes, and beetles. Due to their high metabolism, bats have huge appetites and can consume up to their full body weight in insects every night - this is equivalent to a 100 pound student eating 400-quarter-pound hamburgers! A colony of 10,000 bats, a modest colony size, can devour over 300 pounds of insects in one evening. Just one little brown bat (*Myotis lucifugus*) can catch 600 or more mosquitoes in one hour! Most insectivorous bats catch their food in flight, often using their wings like a catcher’s mitt to capture their prey. If these animals were driven to extinction, there would be nothing to fill their niche in the ecosystem.

BATS

DO ALL BATS EAT INSECTS?

Not all bats eat insects. Fruit bats, found in tropical and subtropical areas, often roost in trees and can be seen during the day. They are nature's most important seed dispersing animal in the tropics and the southwest United States. Few fruit bats use echolocation, but instead rely on their sense of smell and eyesight.

In the tropics and subtropics, countless species of trees and shrubs are pollinated by nectar and pollen eating bats. Three species found in the southwestern United States are responsible for pollinating such plants as the Organ Pipe and Saguaro cacti. Plants pollinated in the wild by fruit, pollen, and nectar-eating bats give us such products as avocados, bananas, cashews, dates, figs, and peaches.

Other bat species have different dietary needs. There are bats that eat rodents, birds, lizards, frogs, and there are even bats that eat other bats. There are fishing bats that use their sonar to detect ripples caused by fish on the surface of a pond. And of course, one cannot forget the vampire bat, the only mammal that can live entirely on blood. There are 3 species of vampire bats all of which are found only in Latin America. The amount of blood these bats consume can be measured in tablespoons rather than pints. They do not suck blood, but lap it up after making a small cut with their incisor teeth. Small mammals and birds are their natural prey, but with the introduction of ranching in Latin America, cattle have become an easy and plentiful source of food.

NOTES:

BAT AND MOTH

ACTIVITY 1

SUBJECTS:
Science, physical education

LOCATION:
Outside, in a large area or in the gym

DURATION:
30 minutes

OBJECTIVE:
Students will be able to define echolocation and demonstrate how bats are able to locate insects and other objects in the dark.

KEY VOCABULARY:
Echolocation

MATERIALS:
1 to 6 blindfolds

METHOD:

1) Have the group form a large circle. Blindfold one student. This student becomes "the bat". Select 2 to 5 other students to become "the moths."

2) Place these students in the center of the circle. Instruct the bat to shout its name "BAT" and each moth to respond by saying their name "MOTH". Each time the bat shouts "BAT", the sound is reflected off the moth and it must respond with its name "MOTH".

3) The blindfolded bat chases and tags the moths. When a moth is tagged, it becomes part of the circle. When the last moth is tagged, it becomes the new bat and the game starts again.

ADAPTATION:
Select two additional students to be trees. When the bat shouts "BAT!", each of the trees must respond with their name, "TREE". Now the bat must not only catch moths, but must avoid running into trees.

Stress that bats are not blind. Blindfolding the students is away of simulating the bat's ability to fly in the dark where eyesight is useless.

This activity was adapted from "Sharing Nature With Children" by Joseph Cornell

BAT FRUIT SALAD

ACTIVITY 2

SUBJECTS:
Social studies, Geography, Science, Math

LOCATION:
Classroom

DURATION:
1 hour

OBJECTIVE:
Students will be able to list foods which bats help to propagate through pollination and seed dispersal. They will be able to discuss the importance of bats to the entire ecosystem.

KEY VOCABULARY:
Pollination, propagation

MATERIALS:
Mixing bowl, knives, spoons (for mixing, serving, and eating), paper cups, napkins, selection of food items from the list below.

METHOD:
Purchase 6 bananas, 5 mangos, 1 box of chopped dates, 1 package of mission or calimyrna figs, 8 oz. package of sweetened carob chips, peaches, 10 oz. can of lightly salted cashews, 5 peach yogurts (8 oz.), and enough guava drink for everyone! All of these ingredients - fruit, nuts, carob - rely on bats for their survival because bats are their sole pollinators and seed dispersers.

Cut the fruit into bite size pieces and place in a large mixing bowl. Mix in the yogurt. Sprinkle with carob chips and chopped cashews and serve in paper cups. Serve a cup of guava drink to each student.

ADAPTATION FOR GRADES 6-8:
Have the students break into groups. Each group will develop a budget and purchase the food items themselves. Each group is to keep a list and compare prices of each item. Discuss the difference it would make if the students lived in another part of the world. Assign a research project for each of the foods listed. Have the groups of students discover the “home land” of each food and why the food was brought to the “New World”. On a map, show where the food was originally grown. Have students research which species of bats pollinates each item.

Adapted from “Educator’s Activity Book About Bats”.
(Bat Conservation International)

BAT WINGS

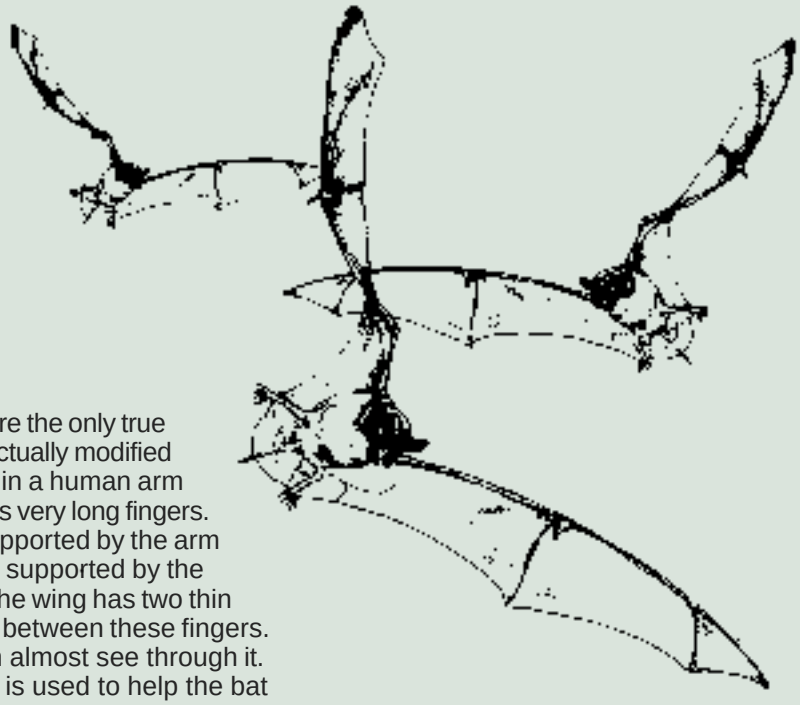
ACTIVITY 3

SUBJECTS:
Science, Art

LOCATION:
Classroom

DURATION:
30-45 minutes

OBJECTIVE:
Students will be able to describe the similarities between a bat skeleton and a human skeleton.



BACKGROUND
Bats are unique animals. They are the only true flying mammals. Bat wings are actually modified arms. The bones are like those in a human arm and hand, except that the bat has very long fingers. The front edge of the wing is supported by the arm bones, with the rest of the wing supported by the bat's elongated finger bones. The wing has two thin layers of flexible skin stretched between these fingers. The skin is so thin that you can almost see through it. The bat's thumb is like a claw; it is used to help the bat move across the rough surfaces of cave walls or tree bark.

KEY VOCABULARY:
Symmetrical, anatomy, comparison, and skeleton

MATERIALS:
Copies of the bat wings pattern, at least 2 colors of construction paper, scissors, and glue.

METHOD:
1) Lead a class discussion about how a bat's wing is like a human hand to assess what students already know. Let them share ideas. Show students the bat wing pattern. Bats have many more bones in their wings than the pattern shows. Because a bat is symmetrical, it will usually have the same number of bones on both sides of the body at approximately the same location.
2) Make copies of the bat wing pattern on the activity page. Hand out scissors, glue, and copies of the pattern to each student. Have each student pick two different colors of construction paper.
3) Have the students cut out wings, trace them twice onto one piece of construction paper and cut out the colored wings. (Remember, one wing needs to be reversed to make opposite wings.) After completing that task, have the students copy the bat wing arm and hand bones a different color than they have colored the bat wing.
4) Use the finished model of the bat wings (that the instructor has made previously) for reference. When the students have completed their bat wings, have them put their names on the backs of both wings. Collect the wings for use in the following activity, "Paper Bag Puppet" or let the students keep the wings and move on to the next activity.

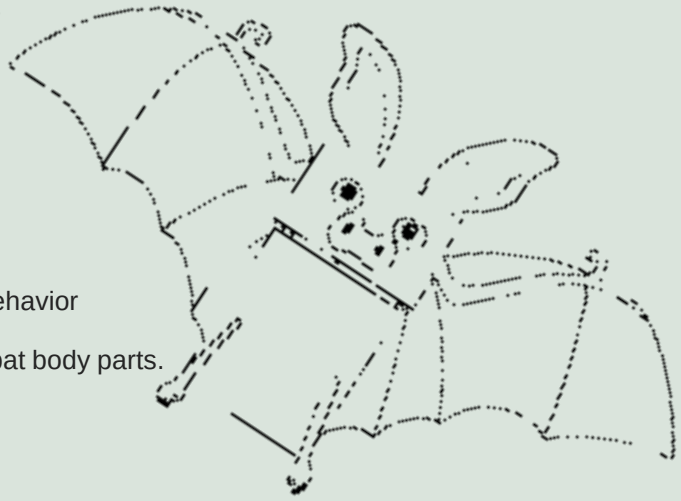
PAPER BAG PUPPETS

ACTIVITY 4

SUBJECTS:
Art, science, Language Arts, Performing Arts

LOCATION:
Classroom

DURATION:
30 minutes to make puppets. Several hours to research, write and present plays



OBJECTIVES:
1) Students will be able to demonstrate bat behavior and discuss bat anatomy.
2) Students will be able to name and locate bat body parts.

BACKGROUND:
See text on pages 1 and 2 of this unit.

KEY VOCABULARY:
Echolocation, wing, and adaptation

MATERIALS:
1 paper bag per student, glue, scissors, construction paper (different colors), templates (see next page), and students' bat wings from previous activity.

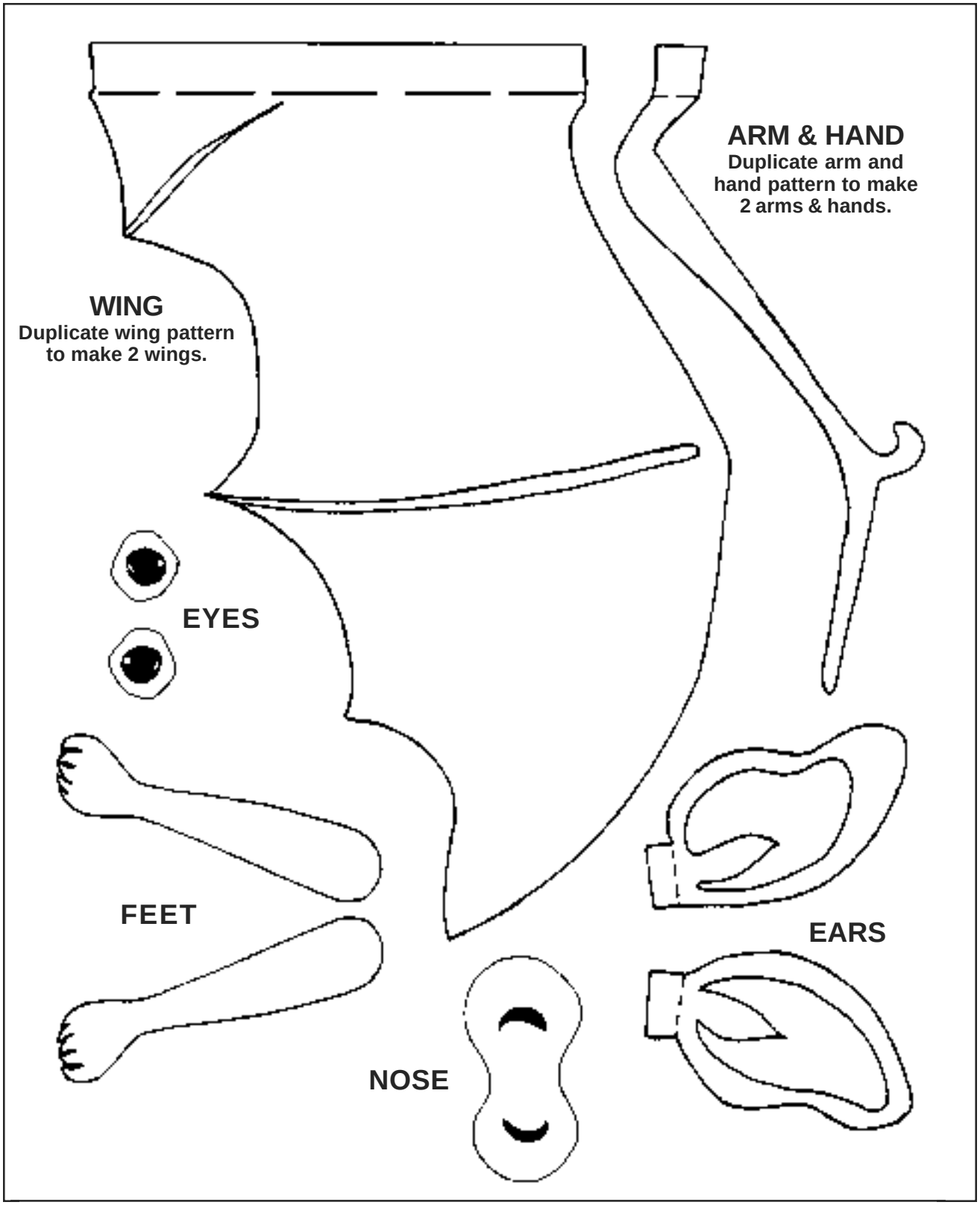
METHOD:
1) Make copies of the bat patterns on the following page. Give a copy to each student. Hand out a paper lunch bag, construction paper, scissors, and glue.
2) Trace templates onto construction paper, making sure that you trace the correct number of parts (two eyes, two ears, etc.). Cut out parts.
3) Using the teacher's finished puppet for reference, have the students glue the bat's body parts in their proper locations. The eyes and the nose are glued to the flap, with the flap acting as a mouth. Do not glue the flap down! Glue the ears on the back of the bag, so they stick up above the head. The feet are glued near the opening of the bag.
4) Hand out the students' pre-made bat wings . Have the students glue them in the side folds of the paper bag.
5) Students can insert their hands in the opening of the bag, making the bat "talk" by moving their hands in the flap.

EXTENSION:
Break the students up into groups and ask them to create short puppet shows about bats. Give each group a certain adaptation or characteristic of bats such as echolocation, eating habits (insectivorous or frugivorous), flying, etc. Students can research their topics or the instructor may provide a discussion for the entire class. Have the students present their short puppet shows using puppets they have made to teach the entire class about their topics. Discuss "old wives tales" about bats with the students. Ask the students what "tales" (bats get stuck in your hair, suck blood, carry rabies, etc.) they have heard in the past and what they think about them now.

NOTE:
When working with small children, some parts may be difficult for them to cut out. Simplify the shape of the part (a simple triangle for ears, etc.); precut that part for them, or delete the part. Some parts can be drawn by hand or colored instead.

BAT PATTERN

ACTIVITY 3 & 4



DOES IT MAKE SENSE?

SUBJECTS:
Science, Math

LOCATION:
Classroom

DURATION:
45-60 minutes

OBJECTIVE:
The students will be able to describe how a mother bat finds her baby among other baby bats.

BACKGROUND:
Many bat species, such as Townsend's big-eared bat, group together in nursery colonies to have their young. With so many bats crowded into a small area, the temperature in that area can be up to 90 degrees or more. When the mother bat leaves in search of food, the pups will huddle together, with as many as 500 baby bats per one square foot. Upon returning the mother bat will find her baby by using her senses of smell and hearing.

KEY VOCABULARY:
Nursery colony, maternity roost

MATERIALS:
Cinnamon oil, clove oil, vanilla extract, mint extract, lemon extract, witch hazel, construction paper, yarn, scissors, and blindfold

METHOD:
1) Explain what a nursery colony is. Ask the students how it might feel to live in a bat colony.
2) Have each student draw a bat on construction paper and cut it out. Using yarn, make a necklace using the paper bat. Designate 5 students to be mother bats and the rest of the students will be the pups. Without any of the pups watching (you may want to have them leave the room, leaving their bat necklaces with you), place a couple of drops of cinnamon oil onto one of the mother bat necklaces. Using the same oil, place a couple of drops onto one of the baby bats. For a second mother bat use clove oil and place a couple of drops onto another of the baby bats. Use the mint, vanilla, and lemon extract for the remaining three mother bats and corresponding baby bats. Use witch-hazel to scent the remaining pups. Allow them to dry.

DOES IT MAKE SENSE?

ACTIVITY 5

3) When the students return, tell them you have put scent on their “bats” and that they are not to discuss their scent with other students. Separate the mothers from the pups. Have each student put on their bat necklace. On one side of the room, line the pups up against the wall. On the other side of the room, blindfold one mother bat. Tell the mother bat to walk across the room and find the pup that matches his/her scent. Record how long it takes the adult bat to find their matching baby bat. Next, blindfold the second adult bat and repeat the process. Continue until all the adult bats have found their pups and the times have been recorded.

4) Have the students trade necklaces to create 5 new adults and different pups. Pair each adult with its correct pup. Have them create a special noise or click that they can use as their own, special identification.

5) Separate the pups by placing them on one side of the room. Blindfold the first adult bat on the other side of the room. Mix the pups around. Have the pups do their special noise or click quietly, each of them using their own unique click or noise. Have the first adult bat try to find its pup by using sound in addition to scent. Repeat the procedure, allowing each adult to find its pup. Record the time it takes for each adult to find their pup. Is this method faster than just using smell alone?

6) Have the students once again trade necklaces. Pair the adults with their correct pups ask them, once again, to create a special click sound. Allow the 5 adult bats to place their pups in a position along the wall. The remaining pups can pick their own spot along the wall. An adult bat is then blindfolded and sets off to find their pup using smell, hearing (the clicks) and memory. Allow each adult to find its pup. Record the time it takes for each adult to find the pup. Is this method faster than the previous ways?

BAT TRIVIA QUESTIONS

1. What size is the smallest bat?
2. What is the largest bat and how big is its wingspan?

Answers:

1. The same size as bumblebee.
2. Flying fox with a 6 foot Wingspan.

WHOSE CAVE IS IT?

ACTIVITY 6

SUBJECTS:
Science, social studies (government), language arts, speech.

LOCATION:
A room set up for a public meeting

DURATION:
Three 45-60 minute periods.

OBJECTIVE:
Students will be able to
1) Identify the social and economical considerations where human uses of land conflict with each other and with wildlife habitat needs.
2) Describe the importance of caves to bats.
3) Identify any possible actions that might be taken to protect bat habitat.

BACKGROUND:
The major threat to the survival of bats, as with most wildlife, is the loss of habitat. People, directly or indirectly, are the cause of most habitat loss. Not all human activity is harmful, but it is important for people to understand the impacts that their actions do have. By learning to make decisions based on all available information, rather than looking at only one aspect of an action, people can minimize their negative impacts on caves and other fragile ecosystems. This activity uses role playing to have students look at multiple sides of an issue. Land management agencies are often charged with making difficult decisions regarding complicated land use issues. Federal agencies must seek public input but are also required to follow their mandates and public laws.

KEY VOCABULARY:
Planning, land use, interest groups, habitat, cave ecosystem, maternity colony, roost, hibernaculum.

MATERIALS:
A room set up for a public meeting and copies of the background information and role descriptions on the following pages.

METHOD:
1) Divide students into up to 8 groups of one or more students. Pick one student to act as the Federal Land Manager, and another group to act as the Federal Agency.
2) Provide students with copies of the background information.
3) If interest groups are represented by more than one person, each group should appoint a spokes-person and a recorder.
4) Provide each group with a card describing its viewpoint.
5) Provide time for groups to research and prepare a presentation for the public meeting. This presentation should state their point of view and any recommendations for the cave management plan.
6) When the groups are ready, the Federal Land Manager will convene the meeting. Each group will present its position, speaking no more than five minutes. The Field Land Manager will maintain order and keep time.
7) After all of the presentations have been made, students representing the Federal Agency will make a decision as to how the cave will be managed, defending their decision with a short explanation.
8) Have all students discuss this decision, how they feel about it, and how people they are representing would feel about this decision.

WHOSE CAVE IS IT?

THIS IS THE FIRST OF THREE MASTER PAGES. MAKE COPIES OF THE INFORMATION BELOW AND ON THE FOLLOWING PAGES. CUT OUT ALONG THE DOTTED LINES AND HAND OUT TO STUDENTS .

STUDENT BACKGROUND:

Old Goat Cave is located on public land managed by the Federal Agency. Over the years, the cave has been used by cavers and local people. It is especially popular with the local cave "grotto" (cave club). Until recently, the cave was only used on an occasional basis.

Bats have been using the cave as long as anyone in the local community can remember. Bats roost in a room near the cave entrance just before the zone of total darkness. Several passageways branch off from this room. Recent research has identified these bats as a maternity colony of *Plecotus townsendii* (Townsend's big-eared bat). Pregnant female bats give birth and raise their young in this cave. They are present from approximately mid-April until the end of August. It is believed that bats are not using the cave as a winter hibernaculum, although no research has been done at that time of the year.

Plecotus townsendii is endangered in other portions of its range, but at this time is not listed on the U.S. Fish and Wildlife Service's Endangered Species List. Although widespread in the West, this species is seldom abundant anywhere, and little is known about its status in this area. It is estimated that the population of bats in Old Goat Cave is about 100 individuals. The size of guano deposits on the floor suggests that historically the cave was used by many more Townsend's big-eared bats and perhaps by other bat species as well.

The Federal Agency is starting to write a Cave Management Plan for Old Goat Cave. They have called a public meeting to obtain public opinion on how the cave should be managed, but in the end, it is the Federal Agency that must make the decision.

VIEW POINT CARD
FEDERAL AGENCY;
SPOKESPERSON: FEDERAL LAND MANAGER

In light of the Federal Cave Resources Protection Act of 1988 and the tremendous increase in recent years in the popularity of recreational caving, you have made it your number one priority to write a cave management plan for Old Goat Cave. Your agency's mandate is to protect the resources while providing for public enjoyment of these resources. The Cave Resources Protection Act requires that all "significant" caves on Federal lands be identified and secured, protected and preserved for the use, enjoyment and benefit of all people. This act allows the manager to regulate and restrict the use of significant caves.

VIEWPOINT CARD
UNIVERSITY RESEARCHERS;
SPOKESPERSON: BIOLOGIST

Under contract to the federal agency, your group has recently conducted a research project on the bats of Old Goat Cave. You are convinced that the bat population in the cave has been decreasing as the recreational caving use has increased. This species is extremely vulnerable to disturbance in its roost. Since very little is known about the status of Townsend's big-eared bat, you believe that this could be an important maternity colony and should be protected. You would like to see the federal agency close the cave to recreational use and install a gate to keep people out while allowing access for the bats.

WHOSE CAVE IS IT?

VIEWPOINT CARD
CAVING COMMUNITY;
SPOKESPERSON: PRESIDENT OF THE STALACTITE GROTTO (LOCAL CAVING CLUB)
Old goat cave is the most interesting and challenging cave in the region and you do not want to lose access to it. If the resident bats were on the endangered list, your members might be agreeable to making the cave off limits to people. However, the bats are not listed, so members are less likely to comply with voluntary closure. You are also against the federal government granting a permit for guano mining or developing the cave for guided tours. You want to keep the cave wild and unaltered.

VIEWPOINT CARD
MINING COMPANY;
SPOKESPERSON: UNEMPLOYED MINING ENGINEER STARTING HIS OWN COMPANY.
You have applied for a permit to mine the bat guano for fertilizer. The natural entrance is small with a steep approach making it difficult to extract the guano easily. You are requesting permission to alter the entrance slightly to make the proposition more economical. You estimate that this mining operation would employ as many as 10 people.

VIEWPOINT CARD
SCOUT TROOP 213;
SPOKESPERSON: SCOUT LEADER
Old Goat Cave is a favorite spot to take your troop for field trips. It is the only cave within 200 miles with which you are familiar and feel comfortable enough to use for badge earning exercises. You, like the members of the Stalactite Grotto, are worried about losing access to the cave.

VIEWPOINT CARD
CHAMBER OF COMMERCE;
SPOKESPERSON: PRESIDENT
You are concerned about the possible loss of dollars to the community if caving enthusiasts are turned away from Old Goat Cave. The region has been economically depressed and would appreciate any income generated by tourism or guano mining. You would actually like to see the federal agency develop the cave for commercial guided tours.

VIEWPOINT CARD
ENVIRONMENTALLY CONCERNED GROUP:
SPOKESPERSON: PRESIDENT OF LOCAL CHAPTER
REPRESENTING THE LOCAL CHAPTER OF THE SIERRA CLUB,
You are in favor of more restrictions on the use of Old Goat Cave. You are concerned, not only for the bats, but also about the degradation of the cave itself. Heavy, unsupervised recreational use is taking its toll in the form of broken speleothems, polluted pools of water, and the introduction of human food and other foreign matter creating unusually high levels of some organisms and depleting others. You believe the cave ecosystem is being completely altered.

WHOSE CAVE IS IT?

EVALUATION:
Is a relatively small population of one species that is unpopular with the general public worth considering in a management plan? Is the cave ecosystem "worthy" of protection? What seem to be the major factors to consider in such land use issues? What responsibilities do we, as citizens, have in helping to make land use decisions? What is the importance of involving all interest groups in the management planning? Can compromises be made without sacrificing the bats or the ecosystem? Describe the possible negative consequences for the bats and the cave if use continues with no planning.

EXTENSION:
What research has been done in your state and surrounding states to protect bats and their habitat? What are the state or federal agencies in your area that have caves in their jurisdiction? Are there cave management plans for any of the caves in your area?

NOTES:

This project was adapted from "Project Wild"

BATTY PICTURE POEMS

ACTIVITY 6

SUBJECTS:
Language arts, speech

LOCATION:
Classroom

DURATION:
30-45 minutes

OBJECTIVE:
Students will be able to express their feelings about these creatures through poetry.

KEY VOCABULARY
Bats

MATERIALS:
Paper, pencil, crayons, colored pencils or paints

METHOD:
1) After teaching a session about bats, ask the students to write poems about bats in general.
2) Have the students illustrate their poems and if they want to, write the words of their poem in the shape of a bat.
3) Ask the students to read their poems to the rest of the class. Lead a discussion and ask the students to express their feelings about bats and how their ideas have changed since learning more about bats.
4) Post the poems where other students can read them and learn about bats.

NOTES: